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SEQUENCE LISTING

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Davin, Laurence B
Lewis, Norman G

<120> Recombinant Secoisolariciresinol Dehydrogenase, and
Methods of Use

<130> WSUR116430

<140> 09/673,918

<141> 2000-10-23

<150> PCT/US99/08975

<151> 1999-04-23

<150> 60/082,977

<151> 1998-04-24

<160> 25

<170> PatentIn Ver. 2.0

<210> 1

<211> 819

<212> DNA

<213> Forsythia x intermedia

<220>

<221> CDS

<222> (1)..(819)

<400> 1

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| atg | cag | ctt | cga | act | gca | ttc | gca | aga | agg | cta | gaa | gga | aaa | gtt | gcc | 48 |
| Met | Gln | Leu | Arg | Thr | Ala | Phe | Ala | Arg | Arg | Leu | Glu | Gly | Lys | Val | Ala | |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| ctt | ata | aca | gga | gga | gcc | agt | gga | att | gga | gaa | acc | aca | gca | aaa | ctc | 96 |
| Leu | Ile | Thr | Gly | Gly | Ala | Ser | Gly | Ile | Gly | Glu | Thr | Thr | Ala | Lys | Leu | |
| | | | 20 | | | | 25 | | | | | | 30 | | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| ttc | tcc | caa | cat | gga | gcc | aaa | gtt | gcc | att | gct | gat | gtc | caa | gat | gaa | 144 |
| Phe | Ser | Gln | His | Gly | Ala | Lys | Val | Ala | Ile | Ala | Asp | Val | Gln | Asp | Glu | |
| | | 35 | | | | | 40 | | | | | 45 | | | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| tta | ggt | cac | tca | gtt | gtc | gag | gcc | att | ggc | act | tcc | aat | tcc | acc | tac | 192 |
| Leu | Gly | His | Ser | Val | Val | Glu | Ala | Ile | Gly | Thr | Ser | Asn | Ser | Thr | Tyr | |
| | 50 | | | | | 55 | | | | 60 | | | | | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| atc | cac | tgt | gat | gtt | act | aat | gaa | gac | ggt | gtt | aaa | aat | gcc | gtg | gac | 240 |
| Ile | His | Cys | Asp | Val | Thr | Asn | Glu | Asp | Gly | Val | Lys | Asn | Ala | Val | Asp | |
| | 65 | | | | 70 | | | | 75 | | | | | 80 | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| aac | aca | gtt | tca | acc | tat | gga | aaa | ctg | gac | att | atg | ttc | agc | aat | gca | 288 |
| Asn | Thr | Val | Ser | Thr | Tyr | Gly | Lys | Leu | Asp | Ile | Met | Phe | Ser | Asn | Ala | |
| | | | | 85 | | | | | 90 | | | | | 95 | | |

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| gga | att | tct | gat | ccc | aac | agg | ccc | cgc | atc | ata | gac | aac | gaa | aaa | gca | 336 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

| | | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Gly | Ile | Ser | Asp | Pro | Asn | Arg | Pro | Arg | Ile | Ile | Asp | Asn | Glu | Lys | Ala | | |
| | | | 100 | | | | | 105 | | | | | 110 | | | | |
| gac | ttt | gaa | cgc | gtt | ctc | agt | gta | aat | gta | acc | gga | gtt | ttc | cta | tgc | 384 | |
| Asp | Phe | Glu | Arg | Val | Leu | Ser | Val | Asn | Val | Thr | Gly | Val | Phe | Leu | Cys | | |
| | | 115 | | | | | 120 | | | | | 125 | | | | | |
| atg | aag | cac | gca | gca | cgt | gtt | atg | att | cca | gca | cgc | agt | ggc | aac | ata | 432 | |
| Met | Lys | His | Ala | Ala | Arg | Val | Met | Ile | Pro | Ala | Arg | Ser | Gly | Asn | Ile | | |
| | 130 | | | | | 135 | | | | | 140 | | | | | | |
| att | tcc | act | gct | agt | tta | agc | tca | act | atg | ggg | ggg | ggg | tct | tca | cat | 480 | |
| Ile | Ser | Thr | Ala | Ser | Leu | Ser | Ser | Thr | Met | Gly | Gly | Gly | Ser | Ser | His | | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | | |
| gcc | tat | tgt | ggg | tca | aag | cat | gct | gtg | tta | gcc | ctt | act | agg | aat | ctg | 528 | |
| Ala | Tyr | Cys | Gly | Ser | Lys | His | Ala | Val | Leu | Ala | Leu | Thr | Arg | Asn | Leu | | |
| | | | | 165 | | | | | 170 | | | | | 175 | | | |
| gca | gtc | gag | ctc | gga | caa | ttt | ggc | att | agg | gtt | aat | tgt | ttg | tct | cct | 576 | |
| Ala | Val | Glu | Leu | Gly | Gln | Phe | Gly | Ile | Arg | Val | Asn | Cys | Leu | Ser | Pro | | |
| | | | 180 | | | | | 185 | | | | | 190 | | | | |
| ttc | ggg | ctt | cct | acg | gct | tta | ggc | aag | aaa | ttt | tca | ggg | att | aaa | aat | 624 | |
| Phe | Gly | Leu | Pro | Thr | Ala | Leu | Gly | Lys | Lys | Phe | Ser | Gly | Ile | Lys | Asn | | |
| | | 195 | | | | | 200 | | | | | 205 | | | | | |
| gaa | gaa | gaa | ttt | gag | aat | gta | ata | aac | ttt | gcg | gga | aat | ttg | aaa | ggg | 672 | |
| Glu | Glu | Glu | Phe | Glu | Asn | Val | Ile | Asn | Phe | Ala | Gly | Asn | Leu | Lys | Gly | | |
| | 210 | | | | | 215 | | | | | 220 | | | | | | |
| cca | aaa | ttt | aat | gtt | gag | gat | gtt | gcc | aat | gca | gct | ctt | tat | ctg | gct | 720 | |
| Pro | Lys | Phe | Asn | Val | Glu | Asp | Val | Ala | Asn | Ala | Ala | Leu | Tyr | Leu | Ala | | |
| | | | | | 230 | | | | | 235 | | | | | 240 | | |
| agt | gat | gag | gca | aaa | tac | gtg | agt | gga | cac | aat | ctg | ttc | att | gat | gga | 768 | |
| Ser | Asp | Glu | Ala | Lys | Tyr | Val | Ser | Gly | His | Asn | Leu | Phe | Ile | Asp | Gly | | |
| | | | | 245 | | | | | 250 | | | | | 255 | | | |
| ggg | ttc | agc | gtc | tgc | aat | tct | gta | atc | aaa | gtg | ttc | caa | tat | cca | gat | 816 | |
| Gly | Phe | Ser | Val | Cys | Asn | Ser | Val | Ile | Lys | Val | Phe | Gln | Tyr | Pro | Asp | | |
| | | | 260 | | | | | 265 | | | | | 270 | | | | |
| tct | | | | | | | | | | | | | | | | 819 | |
| Ser | | | | | | | | | | | | | | | | | |

<210> 2
 <211> 273
 <212> PRT
 <213> Forsythia x intermedia

<400> 2
 Met Gln Leu Arg Thr Ala Phe Ala Arg Arg Leu Glu Gly Lys Val Ala
 1 5 10 15
 Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr Thr Ala Lys Leu
 20 25 30
 Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val Gln Asp Glu

| | | |
|---|-----|-----|
| 35 | 40 | 45 |
| Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser Asn Ser Thr Tyr | | |
| 50 | 55 | 60 |
| Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn Ala Val Asp | | |
| 65 | 70 | 75 |
| Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe Ser Asn Ala | | |
| 85 | 90 | 95 |
| Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp Asn Glu Lys Ala | | |
| 100 | 105 | 110 |
| Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly Val Phe Leu Cys | | |
| 115 | 120 | 125 |
| Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg Ser Gly Asn Ile | | |
| 130 | 135 | 140 |
| Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly Ser Ser His | | |
| 145 | 150 | 155 |
| Ala Tyr Cys Gly Ser Lys His Ala Val Leu Ala Leu Thr Arg Asn Leu | | |
| 165 | 170 | 175 |
| Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro | | |
| 180 | 185 | 190 |
| Phe Gly Leu Pro Thr Ala Leu Gly Lys Lys Phe Ser Gly Ile Lys Asn | | |
| 195 | 200 | 205 |
| Glu Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly Asn Leu Lys Gly | | |
| 210 | 215 | 220 |
| Pro Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala Leu Tyr Leu Ala | | |
| 225 | 230 | 235 |
| Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu Phe Ile Asp Gly | | |
| 245 | 250 | 255 |
| Gly Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe Gln Tyr Pro Asp | | |
| 260 | 265 | 270 |
| Ser | | |

<210> 3
 <211> 831
 <212> DNA
 <213> Forsythia x intermedia

<220>
 <221> CDS
 <222> (1)..(831)

<400> 3
 atg gca gcc act tca cag gtt cta act gca atc gca aga agg cta gaa
 Met Ala Ala Thr Ser Gln Val Leu Thr Ala Ile Ala Arg Arg Leu Glu

| 1 | 5 | 10 | 15 | |
|---|-----|-----|-----|-----|
| gga aaa gtt gcc ctt ata aca gga gga gcc agt gga att gga gaa acc | | | | 96 |
| Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr | 20 | 25 | 30 | |
| aca gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat | | | | 144 |
| Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp | 35 | 40 | 45 | |
| gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc act tcc | | | | 192 |
| Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser | 50 | 55 | 60 | |
| aat tcc acc tac atc cac tgt gat gtt act aat gaa gac ggt gtt aaa | | | | 240 |
| Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys | 65 | 70 | 75 | 80 |
| aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg | | | | 288 |
| Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met | 85 | 90 | 95 | |
| ttc agc aat gca gga att tct gat ccc aac agg ccc cgc atc ata gac | | | | 336 |
| Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp | 100 | 105 | 110 | |
| aac gaa aaa gca gac ttt gaa cgc gtt ttc agt gta aat gta acc gga | | | | 384 |
| Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly | 115 | 120 | 125 | |
| gtt ttc cta tgc atg aag cac gca gca cgt gtt atg att cca gca cgc | | | | 432 |
| Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg | 130 | 135 | 140 | |
| agt ggc aac ata att tcc act gct agt tta agc tca act atg ggt ggt | | | | 480 |
| Ser Gly Asn Ile Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly | 145 | 150 | 155 | 160 |
| ggt tct tca cat gcc tat tgt ggt tca aag cat gct gtg tta ggc ctt | | | | 528 |
| Gly Ser Ser His Ala Tyr Cys Gly Ser Lys His Ala Val Leu Gly Leu | 165 | 170 | 175 | |
| act agg aat ctg gca gtc gag ctc gga caa ttt ggc att agg gtt aat | | | | 576 |
| Thr Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn | 180 | 185 | 190 | |
| tgt ttg tct cct ttc ggg ctt cct acg gct tta ggc aag aaa ttt tca | | | | 624 |
| Cys Leu Ser Pro Phe Gly Leu Pro Thr Ala Leu Gly Lys Lys Phe Ser | 195 | 200 | 205 | |
| ggg att aaa aat gaa gaa gaa ttt gag aat gta ata aac ttt gcg gga | | | | 672 |
| Gly Ile Lys Asn Glu Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly | 210 | 215 | 220 | |
| aat ctg aaa ggt cca aaa ttt aat gtt gag gat gtt gcc aat gca gct | | | | 720 |
| Asn Leu Lys Gly Pro Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala | 225 | 230 | 235 | 240 |
| ctt tat ctg gct agt gat gag gca aaa tac gtg agt gga cac aat ctg | | | | 768 |
| Leu Tyr Leu Ala Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu | | | | |

| | | | | | | |
|---|-----|--|-----|--|-----|-----|
| | 245 | | 250 | | 255 | |
| ttc att gat gga ggg ttc agc gtc tgc aat tct gta atc aaa gtg ttc | | | | | | 816 |
| Phe Ile Asp Gly Gly Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe | | | | | | |
| | 260 | | 265 | | 270 | |
| caa tat cca gat tct | | | | | | 831 |
| Gln Tyr Pro Asp Ser | | | | | | |
| | 275 | | | | | |

<210> 4
 <211> 277
 <212> PRT
 <213> Forsythia x intermedia

<400> 4
 Met Ala Ala Thr Ser Gln Val Leu Thr Ala Ile Ala Arg Arg Leu Glu
 1 5 10 15
 Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr
 20 25 30
 Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp
 35 40 45
 Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser
 50 55 60
 Asn Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys
 65 70 75 80
 Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met
 85 90 95
 Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Arg Pro Arg Ile Ile Asp
 100 105 110
 Asn Glu Lys Ala Asp Phe Glu Arg Val Phe Ser Val Asn Val Thr Gly
 115 120 125
 Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Ile Pro Ala Arg
 130 135 140
 Ser Gly Asn Ile Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly
 145 150 155 160
 Gly Ser Ser His Ala Tyr Cys Gly Ser Lys His Ala Val Leu Gly Leu
 165 170 175
 Thr Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn
 180 185 190
 Cys Leu Ser Pro Phe Gly Leu Pro Thr Ala Leu Gly Lys Lys Phe Ser
 195 200 205
 Gly Ile Lys Asn Glu Glu Glu Phe Glu Asn Val Ile Asn Phe Ala Gly
 210 215 220
 Asn Leu Lys Gly Pro Lys Phe Asn Val Glu Asp Val Ala Asn Ala Ala

| | | | | | | |
|---|---|-----|-----|-----|-----|-----|
| 225 | | 230 | | 235 | | 240 |
| Leu Tyr Leu Ala Ser | Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu | | | | | |
| | 245 | | | 250 | | 255 |
| Phe Ile Asp Gly Gly Phe Ser Val Cys Asn Ser Val Ile Lys Val Phe | | | | | | |
| | 260 | | 265 | | 270 | |
| Gln Tyr Pro Asp Ser | | | | | | |
| | 275 | | | | | |

<210> 5
 <211> 819
 <212> DNA
 <213> Forsythia x intermedia

<220>
 <221> CDS
 <222> (1)..(819)

| | |
|---|-----|
| <400> 5 | |
| atg cag ctt cga act gca atc gca aga agg cta gaa gga aaa gtt gcc | 48 |
| Met Gln Leu Arg Thr Ala Ile Ala Arg Arg Leu Glu Gly Lys Val Ala | |
| 1 5 10 15 | |
| ctt ata aca gga gga gcc agt gga gtt gga gaa gtc aca gca aaa ctc | 96 |
| Leu Ile Thr Gly Gly Ala Ser Gly Val Gly Glu Val Thr Ala Lys Leu | |
| 20 25 30 | |
| ttc tcc caa cat gga gcc aaa gtt gcc att gct gat gtc caa gat gaa | 144 |
| Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val Gln Asp Glu | |
| 35 40 45 | |
| tta ggt cac tca gtt gtc gag gcc att ggc cct tcc aat tcc acc tac | 192 |
| Leu Gly His Ser Val Val Glu Ala Ile Gly Pro Ser Asn Ser Thr Tyr | |
| 50 55 60 | |
| atc cac tgc gat gtt act aat gaa gac ggt gtt aaa aat gcc gtg gac | 240 |
| Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn Ala Val Asp | |
| 65 70 75 80 | |
| aac aca gtt tca acc tat gga aaa ctg gac att atg ttc aac aat gca | 288 |
| Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe Asn Asn Ala | |
| 85 90 95 | |
| gga att tct gat ccc tac aag ccc cgg gtc ata gac aac gaa aaa gca | 336 |
| Gly Ile Ser Asp Pro Tyr Lys Pro Arg Val Ile Asp Asn Glu Lys Ala | |
| 100 105 110 | |
| gac ttt gaa cgc gtt ctc agt gtn aat gtn acc gga gtt ttc cta ttt | 384 |
| Asp Phe Glu Arg Val Leu Ser Xaa Asn Xaa Thr Gly Val Phe Leu Phe | |
| 115 120 125 | |
| atg aag cac gca gca cgc att atg gtt cca gca cga aat ggc tgc ata | 432 |
| Met Lys His Ala Ala Arg Ile Met Val Pro Ala Arg Asn Gly Cys Ile | |
| 130 135 140 | |
| att tcc act gct agt tta agc tca act atg ggt ggt ggt tct tca cat | 480 |
| Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly Ser Ser His | |

| 145 | | 150 | | 155 | | 160 | |
|---|-----|---|---|-----|-----|-----|-----|
| gct tat tgt ggt gca aaa cat gct gta tta ggc ctt act agg aat ctg | 528 | Ala Tyr Cys Gly | Ala Lys His Ala Val Leu Gly Leu Thr Arg Asn Leu | 165 | 170 | 175 | |
| gca gtc gag ctc gga caa ttt ggc att agg gtt aat tgt ttg tct cct | 576 | Ala Val Glu Leu | Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro | 180 | 185 | 190 | |
| ttc ggg ctt cct acg cct cta gcc aag aaa ttt tca ggg att gaa aat | 624 | Phe Gly Leu Pro Thr Pro Leu Ala Lys Lys Phe Ser Gly Ile Glu Asn | | 195 | 200 | 205 | |
| gat gta gac ttt gcg aat gca ata gaa cat gcg gga aat ctg aaa ggt | 672 | Asp Val Asp Phe Ala Asn Ala Ile Glu His Ala Gly Asn Leu Lys Gly | | 210 | 215 | 220 | |
| aca aaa ttg agg att gag gat gtt gcc aat gca gct ctt ttt ctg gct | 720 | Thr Lys Leu Arg Ile Glu Asp Val Ala Asn Ala Ala Leu Phe Leu Ala | | 225 | 230 | 235 | 240 |
| agt gat gag gca caa tat gtg agt gga caa aat ctg ttc atc gat gga | 768 | Ser Asp Glu Ala Gln Tyr Val Ser Gly Gln Asn Leu Phe Ile Asp Gly | | 245 | 250 | 255 | |
| ggg ttc agc gtc tgc aat tct gca atc aaa atg ttc caa tat cca gac | 816 | Gly Phe Ser Val Cys Asn Ser Ala Ile Lys Met Phe Gln Tyr Pro Asp | | 260 | 265 | 270 | |
| tct | 819 | Ser | | | | | |

<210> 6
 <211> 273
 <212> PRT
 <213> Forsythia x intermedia

<400> 6
 Met Gln Leu Arg Thr Ala Ile Ala Arg Arg Leu Glu Gly Lys Val Ala
 1 5 10 15
 Leu Ile Thr Gly Gly Ala Ser Gly Val Gly Glu Val Thr Ala Lys Leu
 20 25 30
 Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val Gln Asp Glu
 35 40 45
 Leu Gly His Ser Val Val Glu Ala Ile Gly Pro Ser Asn Ser Thr Tyr
 50 55 60
 Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn Ala Val Asp
 65 70 75 80
 Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe Asn Asn Ala
 85 90 95
 Gly Ile Ser Asp Pro Tyr Lys Pro Arg Val Ile Asp Asn Glu Lys Ala
 100 105 110

Asp Phe Glu Arg Val Leu Ser Xaa Asn Xaa Thr Gly Val Phe Leu Phe
115 120 125
Met Lys His Ala Ala Arg Ile Met Val Pro Ala Arg Asn Gly Cys Ile
130 135 140
Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly Ser Ser His
145 150 155 160
Ala Tyr Cys Gly Ala Lys His Ala Val Leu Gly Leu Thr Arg Asn Leu
165 170 175
Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys Leu Ser Pro
180 185 190
Phe Gly Leu Pro Thr Pro Leu Ala Lys Lys Phe Ser Gly Ile Glu Asn
195 200 205
Asp Val Asp Phe Ala Asn Ala Ile Glu His Ala Gly Asn Leu Lys Gly
210 215 220
Thr Lys Leu Arg Ile Glu Asp Val Ala Asn Ala Ala Leu Phe Leu Ala
225 230 235 240
Ser Asp Glu Ala Gln Tyr Val Ser Gly Gln Asn Leu Phe Ile Asp Gly
245 250 255
Gly Phe Ser Val Cys Asn Ser Ala Ile Lys Met Phe Gln Tyr Pro Asp
260 265 270

Ser

<210> 7
<211> 831
<212> DNA
<213> Forsythia x intermedia

<220>
<221> CDS
<222> (1)..(831)

<400> 7
atg gcc agt act tca cag gtt cta act gca atc aca aga agg cta gaa 48
Met Ala Ser Thr Ser Gln Val Leu Thr Ala Ile Thr Arg Arg Leu Glu
1 5 10 15
gga aaa gtt gcc ctt ata aca gga gga gcc agt gga att gga gaa ttc 96
Gly Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Phe
20 25 30
aca gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat 144
Thr Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp
35 40 45
gtc caa gat gaa tta ggt cac tca gtt gtc gag gcc atc ggc act tcc 192
Val Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Thr Ser
50 55 60

| | |
|---|-----|
| aat tcc atc tac atc cac tgc gat gtt acc aat gaa gac gat gtt aaa | 240 |
| Asn Ser Ile Tyr Ile His Cys Asp Val Thr Asn Glu Asp Asp Val Lys | |
| 65 70 75 80 | |
| aat gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg | 288 |
| Asn Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met | |
| 85 90 95 | |
| ttc aac aat gca gga att gct gac ccc aac aag ccc cgc atc gta gac | 336 |
| Phe Asn Asn Ala Gly Ile Ala Asp Pro Asn Lys Pro Arg Ile Val Asp | |
| 100 105 110 | |
| aac gaa aaa gca gac ttt gaa cgc gtt ctc agc gta aat gta acc ggt | 384 |
| Asn Glu Lys Ala Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly | |
| 115 120 125 | |
| gtt ttc cta tgc atg aag cac gca gca cgc gtt atg gtg cca gca cgc | 432 |
| Val Phe Leu Cys Met Lys His Ala Ala Arg Val Met Val Pro Ala Arg | |
| 130 135 140 | |
| agt ggc agc ata att tcc act gct agc gta agc tca aca att ggt ggt | 480 |
| Ser Gly Ser Ile Ile Ser Thr Ala Ser Val Ser Ser Thr Ile Gly Gly | |
| 145 150 155 160 | |
| gct gct tca cat gct tat tgt tgt tca aag cat gct gtg tta ggc ctt | 528 |
| Ala Ala Ser His Ala Tyr Cys Cys Ser Lys His Ala Val Leu Gly Leu | |
| 165 170 175 | |
| act agg aat ctg gca gtc gag ctc gga caa ttt ggc att agg gtt aat | 576 |
| Thr Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn | |
| 180 185 190 | |
| tgt ttg gct cct tac gcg ctt gct acg cct tta gcc aag aaa ttt gta | 624 |
| Cys Leu Ala Pro Tyr Ala Leu Ala Thr Pro Leu Ala Lys Lys Phe Val | |
| 195 200 205 | |
| ggg ctt gaa aat gac gaa gat ttg gag aat gca atg agc ctt atg gga | 672 |
| Gly Leu Glu Asn Asp Glu Asp Leu Glu Asn Ala Met Ser Leu Met Gly | |
| 210 215 220 | |
| aat ctg aaa ggt aca aat ttg aag gct gag gac gtc gcc aat gca gct | 720 |
| Asn Leu Lys Gly Thr Asn Leu Lys Ala Glu Asp Val Ala Asn Ala Ala | |
| 225 230 235 240 | |
| ctt tat ctg gca agt gat gag gca aaa tat gtg agt gga cac aat ctg | 768 |
| Leu Tyr Leu Ala Ser Asp Glu Ala Lys Tyr Val Ser Gly His Asn Leu | |
| 245 250 255 | |
| ttc att gat gga ggg ttc agc gtc tac aat tct gca atc aaa atg ttc | 816 |
| Phe Ile Asp Gly Gly Phe Ser Val Tyr Asn Ser Ala Ile Lys Met Phe | |
| 260 265 270 | |
| caa tat cca gac act | 831 |
| Gln Tyr Pro Asp Thr | |
| 275 | |

<210> 8

<211> 277

<212> PRT

<213> Forsythia x intermedia

<400> 8

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Met | Ala | Ser | Thr | Ser | Gln | Val | Leu | Thr | Ala | Ile | Thr | Arg | Arg | Leu | Glu |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Gly | Lys | Val | Ala | Leu | Ile | Thr | Gly | Gly | Ala | Ser | Gly | Ile | Gly | Glu | Phe |
| | | | 20 | | | | | 25 | | | | | 30 | | |
| Thr | Ala | Lys | Leu | Phe | Ser | Gln | His | Gly | Ala | Lys | Val | Ala | Ile | Ala | Asp |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Val | Gln | Asp | Glu | Leu | Gly | His | Ser | Val | Val | Glu | Ala | Ile | Gly | Thr | Ser |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| Asn | Ser | Ile | Tyr | Ile | His | Cys | Asp | Val | Thr | Asn | Glu | Asp | Asp | Val | Lys |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Asn | Ala | Val | Asp | Asn | Thr | Val | Ser | Thr | Tyr | Gly | Lys | Leu | Asp | Ile | Met |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Phe | Asn | Asn | Ala | Gly | Ile | Ala | Asp | Pro | Asn | Lys | Pro | Arg | Ile | Val | Asp |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Asn | Glu | Lys | Ala | Asp | Phe | Glu | Arg | Val | Leu | Ser | Val | Asn | Val | Thr | Gly |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Val | Phe | Leu | Cys | Met | Lys | His | Ala | Ala | Arg | Val | Met | Val | Pro | Ala | Arg |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Ser | Gly | Ser | Ile | Ile | Ser | Thr | Ala | Ser | Val | Ser | Ser | Thr | Ile | Gly | Gly |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Ala | Ala | Ser | His | Ala | Tyr | Cys | Cys | Ser | Lys | His | Ala | Val | Leu | Gly | Leu |
| | | | | 165 | | | | | 170 | | | | | 175 | |
| Thr | Arg | Asn | Leu | Ala | Val | Glu | Leu | Gly | Gln | Phe | Gly | Ile | Arg | Val | Asn |
| | | | 180 | | | | | 185 | | | | | 190 | | |
| Cys | Leu | Ala | Pro | Tyr | Ala | Leu | Ala | Thr | Pro | Leu | Ala | Lys | Lys | Phe | Val |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Gly | Leu | Glu | Asn | Asp | Glu | Asp | Leu | Glu | Asn | Ala | Met | Ser | Leu | Met | Gly |
| | 210 | | | | | 215 | | | | | 220 | | | | |
| Asn | Leu | Lys | Gly | Thr | Asn | Leu | Lys | Ala | Glu | Asp | Val | Ala | Asn | Ala | Ala |
| 225 | | | | | 230 | | | | | 235 | | | | 240 | |
| Leu | Tyr | Leu | Ala | Ser | Asp | Glu | Ala | Lys | Tyr | Val | Ser | Gly | His | Asn | Leu |
| | | | | 245 | | | | | 250 | | | | | 255 | |
| Phe | Ile | Asp | Gly | Gly | Phe | Ser | Val | Tyr | Asn | Ser | Ala | Ile | Lys | Met | Phe |
| | | | 260 | | | | | 265 | | | | | 270 | | |
| Gln | Tyr | Pro | Asp | Thr | | | | | | | | | | | |
| | | | | 275 | | | | | | | | | | | |

<210> 9

<211> 828
 <212> DNA
 <213> Forsythia x intermedia

<220>
 <221> CDS
 <222> (1)..(828)

<400> 9
 atg gcc act tca cag ctt cga act gca ttc gca aga agg cta gaa gga 48
 Met Ala Thr Ser Gln Leu Arg Thr Ala Phe Ala Arg Arg Leu Glu Gly
 1 5 10 15
 aaa gtt gcc ctt ata aca gga gga gcc agt gga gtt gga gaa gtc aca 96
 Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Val Gly Glu Val Thr
 20 25 30
 gca aaa ctc ttc tcc caa cat gga gcc aaa gtt gcc att gct gat gtc 144
 Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val
 35 40 45
 caa gat gaa tta ggt cac tca gtt gtc gag gcc att ggc ctt tcc aat 192
 Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Leu Ser Asn
 50 55 60
 tcc acc tac atc cac tgc gat gtt act aat gaa gac ggt gtt aaa aat 240
 Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn
 65 70 75 80
 gcc gtg gac aac aca gtt tca acc tat gga aaa ctg gac att atg ttc 288
 Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe
 85 90 95
 aac aat gca gga att tct gat ccc tac aag ccc cgg gtc ata gac aac 336
 Asn Asn Ala Gly Ile Ser Asp Pro Tyr Lys Pro Arg Val Ile Asp Asn
 100 105 110
 gaa aaa gca gac ttt gaa cgc gtt ctc agt gtt aat gta acc gga gtt 384
 Glu Lys Ala Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly Val
 115 120 125
 ttc cta ttt atg aag cac gca gca cgc att atg gtt cca gca cga agt 432
 Phe Leu Phe Met Lys His Ala Ala Arg Ile Met Val Pro Ala Arg Ser
 130 135 140
 ggc tgc ata att tcc act gct agt tta agc tca act atg ggt ggt ggt 480
 Gly Cys Ile Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly
 145 150 155 160
 tct tca cat gct tat tgt ggt tca aag cat gct gta tta ggc ctt act 528
 Ser Ser His Ala Tyr Cys Gly Ser Lys His Ala Val Leu Gly Leu Thr
 165 170 175
 agg aat ctg gca gtc gag ctc gga caa ttt ggc att agg gtt aat tgt 576
 Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys
 180 185 190
 ttg tct cct ttc ggg ctt cct acg cct tta gcc aag aaa ttt aca ggg 624
 Leu Ser Pro Phe Gly Leu Pro Thr Pro Leu Ala Lys Lys Phe Thr Gly
 195 200 205

| | |
|---|-----|
| att gaa aat gat gaa gac ttg gcg aat gga ata gaa cgt gcg gga aat | 672 |
| Ile Glu Asn Asp Glu Asp Leu Ala Asn Gly Ile Glu Arg Ala Gly Asn | |
| 210 215 220 | |
| ctg aaa ggt aca aaa ttg agg att gag gat gtt gcc aat gca gct ctt | 720 |
| Leu Lys Gly Thr Lys Leu Arg Ile Glu Asp Val Ala Asn Ala Ala Leu | |
| 225 230 235 240 | |
| ttt ctg gct agt gat gag gca caa tat gtg agt gga caa aat ctg ttc | 768 |
| Phe Leu Ala Ser Asp Glu Ala Gln Tyr Val Ser Gly Gln Asn Leu Phe | |
| 245 250 255 | |
| atc gat gga ggg ttc agc gtc tgc aat tct gca atc aaa ttg ttc caa | 816 |
| Ile Asp Gly Gly Phe Ser Val Cys Asn Ser Ala Ile Lys Leu Phe Gln | |
| 260 265 270 | |
| tat cca gac tct | 828 |
| Tyr Pro Asp Ser | |
| 275 | |

<210> 10
 <211> 276
 <212> PRT
 <213> Forsythia x intermedia

<400> 10
 Met Ala Thr Ser Gln Leu Arg Thr Ala Phe Ala Arg Arg Leu Glu Gly
 1 5 10 15
 Lys Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Val Gly Glu Val Thr
 20 25 30
 Ala Lys Leu Phe Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val
 35 40 45
 Gln Asp Glu Leu Gly His Ser Val Val Glu Ala Ile Gly Leu Ser Asn
 50 55 60
 Ser Thr Tyr Ile His Cys Asp Val Thr Asn Glu Asp Gly Val Lys Asn
 65 70 75 80
 Ala Val Asp Asn Thr Val Ser Thr Tyr Gly Lys Leu Asp Ile Met Phe
 85 90 95
 Asn Asn Ala Gly Ile Ser Asp Pro Tyr Lys Pro Arg Val Ile Asp Asn
 100 105 110
 Glu Lys Ala Asp Phe Glu Arg Val Leu Ser Val Asn Val Thr Gly Val
 115 120 125
 Phe Leu Phe Met Lys His Ala Ala Arg Ile Met Val Pro Ala Arg Ser
 130 135 140
 Gly Cys Ile Ile Ser Thr Ala Ser Leu Ser Ser Thr Met Gly Gly Gly
 145 150 155 160
 Ser Ser His Ala Tyr Cys Gly Ser Lys His Ala Val Leu Gly Leu Thr
 165 170 175

Arg Asn Leu Ala Val Glu Leu Gly Gln Phe Gly Ile Arg Val Asn Cys
180 185 190

Leu Ser Pro Phe Gly Leu Pro Thr Pro Leu Ala Lys Lys Phe Thr Gly
195 200 205

Ile Glu Asn Asp Glu Asp Leu Ala Asn Gly Ile Glu Arg Ala Gly Asn
210 215 220

Leu Lys Gly Thr Lys Leu Arg Ile Glu Asp Val Ala Asn Ala Ala Leu
225 230 235 240

Phe Leu Ala Ser Asp Glu Ala Gln Tyr Val Ser Gly Gln Asn Leu Phe
245 250 255

Ile Asp Gly Gly Phe Ser Val Cys Asn Ser Ala Ile Lys Leu Phe Gln
260 265 270

Tyr Pro Asp Ser
275

<210> 11
<211> 21
<212> PRT
<213> Forsythia x intermedia

<220>
<221> PEPTIDE
<222> (1)..(21)
<223> N-terminal peptide of F. intermedia
secoisolariciresinol protein wherein Xaa at
positions 3, 12 and 20 represents an unidentified
amino acid residue

<400> 11
Gln Val Xaa Thr Ala Ile Ala Arg Asp Leu Glu Xaa Lys Val Ala Leu
1 5 10 15

Ile Thr Gly Xaa Ala
20

<210> 12
<211> 17
<212> PRT
<213> Forsythia x intermedia

<400> 12
Val Ala Leu Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr Thr Ala
1 5 10 15

Lys

<210> 13
<211> 15
<212> PRT

<213> Forsythia x intermedia

<400> 13

Leu Asn Ile Met Phe Ser Asn Ala Gly Ile Ser Asp Pro Asn Lys
1 5 10 15

<210> 14

<211> 20

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
oligonucleotide

<220>

<221> misc_feature

<222> (1)..(20)

<223> PCR primer wherein n at positions 3, 9, 15 and 18
represents inosine

<400> 14

ggnathggng aracnacngc

20

<210> 15

<211> 20

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
oligonucleotide

<220>

<221> misc_feature

<222> (1)..(20)

<223> PCR primer wherein n at positions 3 and 9
represents inosine

<400> 15

ccngcrttng araacatdat

20

<210> 16

<211> 20

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
oligonucleotide

<220>

<221> misc_feature

<222> (1)..(20)

<223> PCR primer wherein n at positions 3 and 9
represents inosine

<400> 16
ccngcrttnc traacatdat 20

<210> 17
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
oligonucleotide

<220>
<221> misc_feature
<222> (1)..(20)
<223> PCR primer

<400> 17
attccgctag attgcattga 20

<210> 18
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
oligonucleotide

<220>
<221> misc_feature
<222> (1)..(20)
<223> PCR primer wherein n at positions 3 and 9
represent inosine

<400> 18
ccngcrttnc traacatdat 20

<210> 19
<211> 20
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
oligonucleotide

<220>
<221> misc_feature
<222> (1)..(20)
<223> T7 PCR primer

<400> 19
aattaaccct cactaaaggg 20

<210> 20

<211> 23
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:
 oligonucleotide

<220>
 <221> misc_feature
 <222> (1)..(23)
 <223> PCR primer

<400> 20
 cagcttcgaa ctgcattcgc aag 23

<210> 21
 <211> 22
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:
 oligonucleotide

<220>
 <221> misc_feature
 <222> (1)..(22)
 <223> T7 PCR primer

<400> 21
 cgggatatca ctcagcataa tg 22

<210> 22
 <211> 816
 <212> DNA
 <213> Forsythia x intermedia

<220>
 <221> CDS
 <222> (1)..(816)

<400> 22
 cag ctt cga act gca ttc gca aga agg cta gaa gga aaa gtt gcc ctt 48
 Gln Leu Arg Thr Ala Phe Ala Arg Arg Leu Glu Gly Lys Val Ala Leu
 1 5 10 15
 ata aca gga gga gcc agt gga att gga gaa acc aca gca aaa ctc ttc 96
 Ile Thr Gly Gly Ala Ser Gly Ile Gly Glu Thr Thr Ala Lys Leu Phe
 20 25 30
 tcc caa cat gga gcc aaa gtt gcc att gct gat gtc caa gat gaa tta 144
 Ser Gln His Gly Ala Lys Val Ala Ile Ala Asp Val Gln Asp Glu Leu
 35 40 45
 ggt cac tca gtt gtc gag gcc att ggc act tcc aat tcc acc tac atc 192
 Gly His Ser Val Val Glu Ala Ile Gly Thr Ser Asn Ser Thr Tyr Ile
 50 55 60

| | | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| cac | tgt | gat | gtt | act | aat | gaa | gac | ggg | gtt | aaa | aat | gcc | gtg | gac | aac | 240 |
| His | Cys | Asp | Val | Thr | Asn | Glu | Asp | Gly | Val | Lys | Asn | Ala | Val | Asp | Asn | |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 | |
| aca | gtt | tca | acc | tat | gga | aaa | ctg | gac | att | atg | ttc | agc | aat | gca | gga | 288 |
| Thr | Val | Ser | Thr | Tyr | Gly | Lys | Leu | Asp | Ile | Met | Phe | Ser | Asn | Ala | Gly | |
| | | | | 85 | | | | | 90 | | | | | 95 | | |
| att | tct | gat | ccc | aac | agg | ccc | cgc | atc | ata | gac | aac | gaa | aaa | gca | gac | 336 |
| Ile | Ser | Asp | Pro | Asn | Arg | Pro | Arg | Ile | Ile | Asp | Asn | Glu | Lys | Ala | Asp | |
| | | | 100 | | | | | 105 | | | | | 110 | | | |
| ttt | gaa | cgc | gtt | ctc | agt | gta | aat | gta | acc | gga | gtt | ttc | cta | tgc | atg | 384 |
| Phe | Glu | Arg | Val | Leu | Ser | Val | Asn | Val | Thr | Gly | Val | Phe | Leu | Cys | Met | |
| | | 115 | | | | | 120 | | | | | 125 | | | | |
| aag | cac | gca | gca | cgt | gtt | atg | att | cca | gca | cgc | agt | ggc | aac | ata | att | 432 |
| Lys | His | Ala | Ala | Arg | Val | Met | Ile | Pro | Ala | Arg | Ser | Gly | Asn | Ile | Ile | |
| | 130 | | | | | 135 | | | | | 140 | | | | | |
| tcc | act | gct | agt | tta | agc | tca | act | atg | ggg | ggg | ggg | tct | tca | cat | gcc | 480 |
| Ser | Thr | Ala | Ser | Leu | Ser | Ser | Thr | Met | Gly | Gly | Gly | Ser | Ser | His | Ala | |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 | |
| tat | tgt | ggg | tca | aag | cat | gct | gtg | tta | gcc | ctt | act | agg | aat | ctg | gca | 528 |
| Tyr | Cys | Gly | Ser | Lys | His | Ala | Val | Leu | Ala | Leu | Thr | Arg | Asn | Leu | Ala | |
| | | | | 165 | | | | 170 | | | | | | 175 | | |
| gtc | gag | ctc | gga | caa | ttt | ggc | att | agg | gtt | aat | tgt | ttg | tct | cct | ttc | 576 |
| Val | Glu | Leu | Gly | Gln | Phe | Gly | Ile | Arg | Val | Asn | Cys | Leu | Ser | Pro | Phe | |
| | | | 180 | | | | | 185 | | | | | 190 | | | |
| ggg | ctt | cct | acg | gct | tta | ggc | aag | aaa | ttt | tca | ggg | att | aaa | aat | gaa | 624 |
| Gly | Leu | Pro | Thr | Ala | Leu | Gly | Lys | Lys | Phe | Ser | Gly | Ile | Lys | Asn | Glu | |
| | | 195 | | | | | 200 | | | | | 205 | | | | |
| gaa | gaa | ttt | gag | aat | gta | ata | aac | ttt | gcg | gga | aat | ttg | aaa | ggg | cca | 672 |
| Glu | Glu | Phe | Glu | Asn | Val | Ile | Asn | Phe | Ala | Gly | Asn | Leu | Lys | Gly | Pro | |
| | | 210 | | | | 215 | | | | | 220 | | | | | |
| aaa | ttt | aat | gtt | gag | gat | gtt | gcc | aat | gca | gct | ctt | tat | ctg | gct | agt | 720 |
| Lys | Phe | Asn | Val | Glu | Asp | Val | Ala | Asn | Ala | Ala | Leu | Tyr | Leu | Ala | Ser | |
| 225 | | | | | 230 | | | | 235 | | | | | | 240 | |
| gat | gag | gca | aaa | tac | gtg | agt | gga | cac | aat | ctg | ttc | att | gat | gga | ggg | 768 |
| Asp | Glu | Ala | Lys | Tyr | Val | Ser | Gly | His | Asn | Leu | Phe | Ile | Asp | Gly | Gly | |
| | | | | 245 | | | | 250 | | | | | | 255 | | |
| ttc | agc | gtc | tgc | aat | tct | gta | atc | aaa | gtg | ttc | caa | tat | cca | gat | tct | 816 |
| Phe | Ser | Val | Cys | Asn | Ser | Val | Ile | Lys | Val | Phe | Gln | Tyr | Pro | Asp | Ser | |
| | | | 260 | | | | | 265 | | | | | 270 | | | |

<210> 23

<211> 272

<212> PRT

<213> Forsythia x intermedia

<400> 23

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Gln | Leu | Arg | Thr | Ala | Phe | Ala | Arg | Arg | Leu | Glu | Gly | Lys | Val | Ala | Leu |
| 1 | | | | 5 | | | | | 10 | | | | | 15 | |
| Ile | Thr | Gly | Gly | Ala | Ser | Gly | Ile | Gly | Glu | Thr | Thr | Ala | Lys | Leu | Phe |
| | | 20 | | | | | | 25 | | | | | 30 | | |
| Ser | Gln | His | Gly | Ala | Lys | Val | Ala | Ile | Ala | Asp | Val | Gln | Asp | Glu | Leu |
| | | 35 | | | | | 40 | | | | | 45 | | | |
| Gly | His | Ser | Val | Val | Glu | Ala | Ile | Gly | Thr | Ser | Asn | Ser | Thr | Tyr | Ile |
| | 50 | | | | | 55 | | | | | 60 | | | | |
| His | Cys | Asp | Val | Thr | Asn | Glu | Asp | Gly | Val | Lys | Asn | Ala | Val | Asp | Asn |
| 65 | | | | | 70 | | | | | 75 | | | | | 80 |
| Thr | Val | Ser | Thr | Tyr | Gly | Lys | Leu | Asp | Ile | Met | Phe | Ser | Asn | Ala | Gly |
| | | | | 85 | | | | | 90 | | | | | 95 | |
| Ile | Ser | Asp | Pro | Asn | Arg | Pro | Arg | Ile | Ile | Asp | Asn | Glu | Lys | Ala | Asp |
| | | | 100 | | | | | 105 | | | | | 110 | | |
| Phe | Glu | Arg | Val | Leu | Ser | Val | Asn | Val | Thr | Gly | Val | Phe | Leu | Cys | Met |
| | | 115 | | | | | 120 | | | | | 125 | | | |
| Lys | His | Ala | Ala | Arg | Val | Met | Ile | Pro | Ala | Arg | Ser | Gly | Asn | Ile | Ile |
| | 130 | | | | | 135 | | | | | 140 | | | | |
| Ser | Thr | Ala | Ser | Leu | Ser | Ser | Thr | Met | Gly | Gly | Gly | Ser | Ser | His | Ala |
| 145 | | | | | 150 | | | | | 155 | | | | | 160 |
| Tyr | Cys | Gly | Ser | Lys | His | Ala | Val | Leu | Ala | Leu | Thr | Arg | Asn | Leu | Ala |
| | | | | 165 | | | | | 170 | | | | | 175 | |
| Val | Glu | Leu | Gly | Gln | Phe | Gly | Ile | Arg | Val | Asn | Cys | Leu | Ser | Pro | Phe |
| | | | 180 | | | | | 185 | | | | | 190 | | |
| Gly | Leu | Pro | Thr | Ala | Leu | Gly | Lys | Lys | Phe | Ser | Gly | Ile | Lys | Asn | Glu |
| | | 195 | | | | | 200 | | | | | 205 | | | |
| Glu | Glu | Phe | Glu | Asn | Val | Ile | Asn | Phe | Ala | Gly | Asn | Leu | Lys | Gly | Pro |
| | 210 | | | | | 215 | | | | | 220 | | | | |
| Lys | Phe | Asn | Val | Glu | Asp | Val | Ala | Asn | Ala | Ala | Leu | Tyr | Leu | Ala | Ser |
| 225 | | | | | 230 | | | | | 235 | | | | | 240 |
| Asp | Glu | Ala | Lys | Tyr | Val | Ser | Gly | His | Asn | Leu | Phe | Ile | Asp | Gly | Gly |
| | | | | 245 | | | | | 250 | | | | | 255 | |
| Phe | Ser | Val | Cys | Asn | Ser | Val | Ile | Lys | Val | Phe | Gln | Tyr | Pro | Asp | Ser |
| | | | 260 | | | | | 265 | | | | | 270 | | |

<210> 24

<211> 33

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
oligonucleotide

<220>
<221> misc_feature
<222> (1)..(33)
<223> PCR primer

<400> 24
acatatgcag cttcgaactg cattcgcaag aag

33

<210> 25
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
oligonucleotide

<220>
<221> misc_feature
<222> (1)..(33)
<223> PCR primer

<400> 25
catatgggca gacatgttac atgatcaatt gca

33